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INVESTIGATION OF SOME SPORE GENERA FROM THE LOWER AND MIDDLE CRETACEOUS IN TRANSDANUBIA

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Abstract

The author has investigated the foveate, foveoreticulate, foveorugulate and raretuberculate spores occurring in the spore-pollen complexes of the Lower and Middle Cretaceous rocks in Transdanubia (Hungary), and separated some species to *Ischyosporites*, *Klukisporites*, *Foveasporis* and *Acritosporites* genera. He created a new formgenus, *Fueloepisporites*, with five new species. From among these, the species of *Klukisporites*, *Ischyosporites* and *Fueloepisporites* are primarily suitable for characterizing the sediments older than the Albian; *Acritosporites* and *Foveasporis* are frequent in the Albian-Cenomanian sediments.

The examined spore-types are in most probably botanical relationship with the Lygodiaceae and Klukiaceafern families.

Introduction

The sedimentary rocks of the Lower and Middle Cretaceous can be found in the western part of Hungary, in the Transdanubian Central Mountains and Villány Mountains. Several geological formations have already been described by HAAS et al (1977).

In the course of studying the spore-pollen complexes of these formations, some spore-types that are interesting morphologically, and from the point of view of nomenclature and botany, as well, were found. We should like to deal with these in our paper in greater detail.

Previous works

From among the Jurassic—Cretaceous spores, a number of formgenera have arisen for taking in the foveate-foveoreticulate spores. BALME (1957) created the genus *Ischyosporites* for taking in the trilete forms with foveoreticulate ornamentation on the distal face of spore, and which are valvate but with smooth or punctate proximal surface. COUPER (1958) placed the proximally smooth to granulate but distally foveoreticulate, non-valvate forms into the genus *Klukisporites*. KRUTZSCH (1959b) proposed the formgenus *Foveasporis* for taking in the forms that are both proximally and distally foveate-foveoreticulate. As in several cases of Mesozoic spores, problems of nomenclature have arisen here too.

DÖRING (1965), SCHULZ (1967), TRALAU (1968) and GUY (1971) think that the valvate or non-valvate character of spores is not sufficient for separating two genera, and giving priority to the Ischyosporites BALME 1957, they consider *Klukisporites* as a junior synonym of the former genus. GUY (1971) goes even further in restric-

tion, placing the majority of the species classified in these two genera into a single species, *Ischyosporites variegatus* (COUPER 1958) SCHULZ 1967.

DETTMANN (1963) proposed that both genera are valid, an separated them on the basis of the presence or lack of equatorial wall-thickening (valvae). SINGH (1971) and SRIVASTAVA (1975) agree with Dettmann's conception and we also accept this. The proximally foveate spores may be classified into the emended genus *Foveaspo-ris* (W. KR.), while we have not found any genus for taking in the spores that are foveorugulate sculpture on their proximal and distal surface. For these, we suggest, therefore, the introduction of the new formgenus *Fueloepisporites*.

An interesting group of spores is a raretuberculate formgroup, described by different authors in different genera, although the genus *Acritosporites*, created by OBONIZKAJA (1964), is very suitable for taking in these spores, which come mostly from the Upper Cretaceous.

Systematic part

Genus: ISCHYOSPORITES BALME 1957
Type species: *Ischyosporites crateris* BALME 1957

Ischyosporites estherae DEÁK 1964
Pl. 1., figs. 1, 2.

1964 *Ischyosporites estherae* n.sp.
DEÁK, p. 103–104, Pl. 5, figs. 36, 37, and Pl. 6, figs. 41–44.

Remarks: *Ischyosporites estherae* DEÁK is a large-sized (67–90 μ) thick-walled spore, the distal surface of which is generally foveoreticulate, the lumina have a diameter of 6–12 μ and are hexagonal or polygonal, rarely roundish. The exine is valvate at the corners, the ornamenting elements in part pass through to the proximal surface, the contact area of which is smooth.

Occurrence: It can be found in the Middle Albian coaly-clay sediments of the Tés Formation, generally together with similarly thick-walled *Plicatella trichacantha* MALJ., and *Matonisporites* species. We may suppose that its mother plant lived in a vegetation close to a riverside or in a marsh.

Ischyosporites baconicus n.fsp.
Pl. 1., figs. 3, 4.

Holotype: Pl. 1., figs. 3, 4. Prep.: Ot-84, 11/1. P: 39.7/95.
Locus typicus: Olaszfalu, Mts Bakony, Borehole Ot-84, 110 m.
Stratum typicum: Tés Formation, clayey-coal. Middle Albian.

Diagnosis: trilete, triangular miospores, with convex or straight sides, rounded corners. Laesura is straight, r=4/5. The distal surface is strongly convex, with foveoreticulate ornamentation. Muri are of various thicknesses (2–7 μ). The lumina similarly vary in size and shape. They may be roundish-polygonal or elongated, wide canal-like. In this species they are 2–5 μ wide, 4–5 μ long. The ornamenting elements bring about thickening at the equatorial corners (valvae), in part passing through to the proximal surface, as far as the end of the laesura. Along the inter-radial sides, thin ridges may similarly extend over the proximal part, the contact area of which is always smooth.

Spore size: 51–65 μ.

Differential diagnosis: The new species differs from *Ischyosporites estherae* DEÁK in its smaller size, thinner (1.5–3 μ) exine, and irregular foveoreticulate to reticulate distal ornamentation. It may form a transition between *Ischyosporites* and *Cicatricosisporites*.

Occurrence: In the sediments of the Tés Formation, mainly in some coaly-clayey strata in borehole Tt-27, and Ot-84.

Genus: KLUKISPORITES COUPER 1958
Type species: *Klukisporites variegatus* COUPER 1958

Klukisporites foveolatus POCOCK 1964
Pl. 1., figs. 5, 6.

Remarks: The holotype described by POCOCK (1964) is of 36–42 μ in size, the proximal surface of the spore is smooth, at the distal surface the foveolae are 2.5–5 μ in diameter, circular. The spore examined by us is 40 μ in size, the diameter of the lumina is 3–5 μ.

Occurrence: In Hungary, in the marl of the Pénzeskút Formation (Upper Albian — Lower Cenomanian). In Canada: Upper Mannville (Pocock, 1964), Loon River Formation (SINGH, 1971).

Klukisporites scaberis (COOKS. et DETT. 1958) DETT. 1963
Pl. 1., figs. 7, 8.

1958 *Ischyosporites scaberis* sp.nov.
COOKSON et DETTMANN, p. 104, Pl. 15, figs. 7, 9.
1963 *Klukisporites scaberis* (COOKS. et DETT. 1958) n.comb.
DETTMANN, p. 48, Pl. 8, figs. 1–7. Otway Basin, Australia, Albian.

Occurrence: Hungary: in aleurolitic sediments of Vértessomló Formation (Lower Albian).

Klukisporites lacunus FILATOFF 1975
Pl. 1., figs. 9, 10.

1975 *Klukisporites lacunus* n.sp.
FILATOFF, p. 69–70, Pl. 15, fig. 9, and Pl. 16, figs. 1, 2.

Remarks: The holotype of this species is 44 μ in size, its lumina are 4–10 μ, 25–40 of them are to be found on the distal surface of the spore. The size of the species examined by us is 42–56 μ, diameter of the lumina is 5–9 μ, 22–28 of them can be found on the distal surface. The proximal surface is smooth.

Occurrence: In the sediments of the Sümeg Formation (Barremian-Aptian), and Vértessomló Formation (Lower Albian).

Klukisporites tuberosus (DÖRING 1965) n.comb.
Pl. 2., figs. 1, 2.

1965 *Ischyosporites tuberosus* n.sp.
DÖRING, p. 43, Pl. 16, figs. 4–6. Westmecklenburg (GDR), Wealden A.

Occurrence: In Hungary, it generally occurs in the Neocomian sediments of the Mts Gerecse and the Barremian rocks of the Mts Bakony.

Genus: FOVEASPORIS (W. KR. 1959b) emend.

Type species: *Foveasporis fovearis* W. KR. 1959b.

Emended diagnosis: trilete miospores, with circular amb. The exine sculpture is foveate on both the proximal and distal surfaces. On both surfaces the lumina of the foveae may be of various sizes. Their shape is generally regular, of circular outline. These lumina are often large but they are not arranged in rows. Muri are strong, massive. The laesura is simple, often short, r=1/3—1/4.

Remarks: KRUTZSCH (1959b, p. 162) mentions in the genusdiagnosis — probably due to a misprint — "azonomonolete microspores". He does not mention the ornamentation of the proximal surface, although this is the important character for separating Foveasporis from the genera *Ischyosporites* and *Klukisporites*, also of non-foveate proximal surface. In his latter work, KRUTZSCH (1963, p. 14) separates three genera from each other, but then with both the other genera he emphasizes the irregularity of the lumina, which is not a fundamental diagnostic character either for the genus diagnosis of these or in the description of the species in thesem genera.

Cretaceous forms to be classified in the genus:

1. *Foveasporis agathoecus* (R. POT. 1934) W. KR. 1959b.
2. *Foveasporis* (al. *Foveotriletes*) *budejovicensis* (PACLT. 1961) n.comb.
3. *Foveasporis crassiexinous* (BRENNER 1963) DÖRING 1966

Foveasporis agathoecus (R. POT. 1934) W. KR. 1959b
Pl. 1., figs. 11, 12.

1934b *Sporites agathoecus* n.sp.
R. POTONIÉ, p. 43, Pl. 1, fig. 25. Geiseltal, lower part of Upper Cretaceous.
1959b *Foveasporis agathoecus* (R. POT. 1934) n.comb.
KRUTZSCH, p. 165, Pl. 30, figs. 334–335. Geiseltal, Turonian.

Remarks: This spore of circular outline and medium size (45–60 μ) has a 3–5 μ thick exine and, on both sides, with large foveas (3–12 μ in diameter).

Occurrence: It is a spore-type of the Upper Cretaceous. In Hungary, it was first found in the upper section of the Pénzeskút Formation (Lower Cenomanian).

Genus: FUELOEPISPORITES nov.gen.

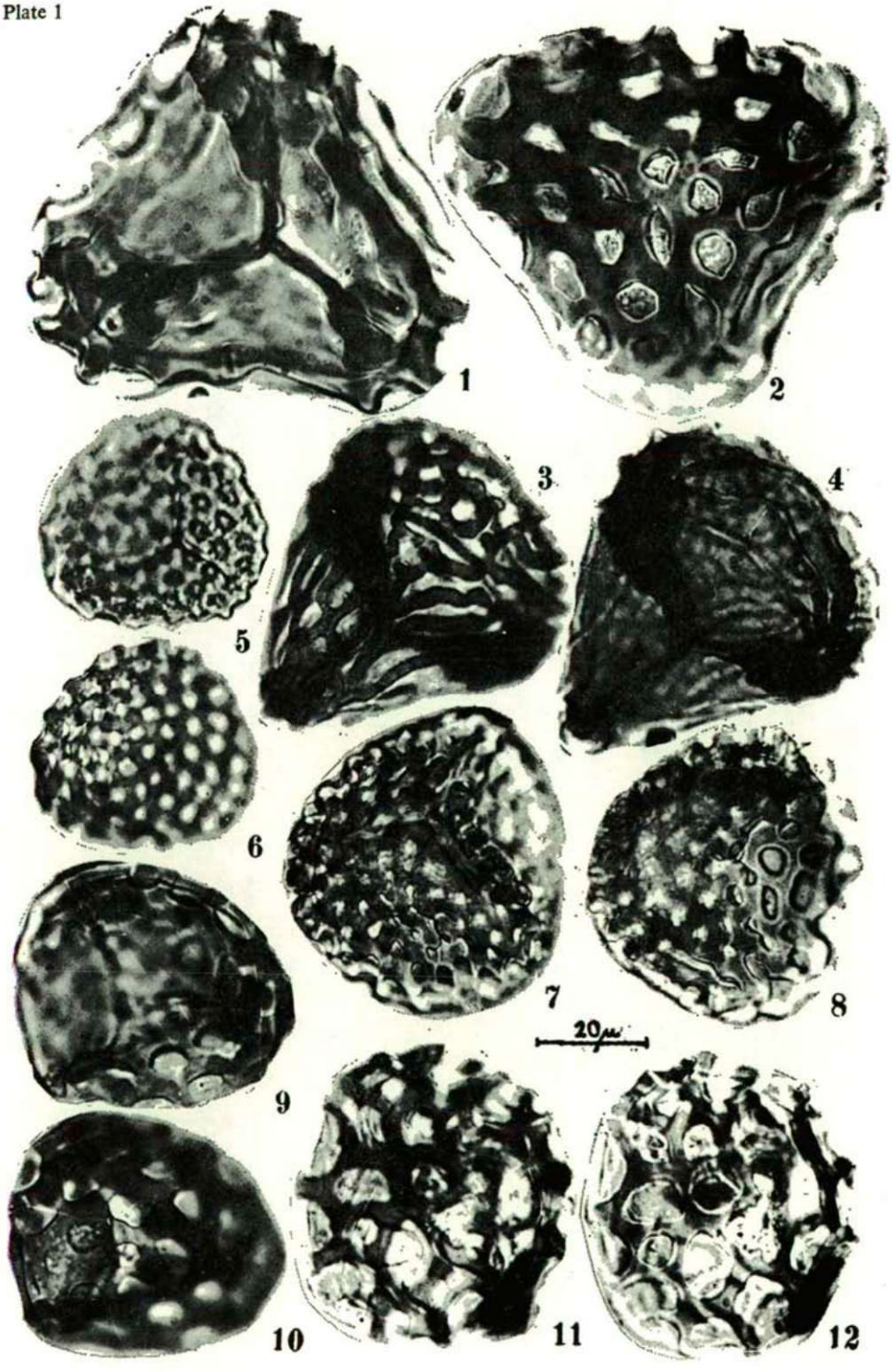
Type species: *Fueloepisporites hungaricus* n.fsp.

Derivatio nominis: In honour of the Hungarian geologist, DR. JÓZSEF FÜLÖP.

PLATE 1

1, 2 *Ischyosporites estherae* DEÁK 1964.
Súr (Bakony Mts), Bore Súr-1, Prep. 556/3. P: 42/98,3. Middle Albian.
3, 4 *Ischyosporites baconicus* n. sp.
Olaszfalu (Bakony Mts), Bore Ot-84, Prep. 11/1. P: 39,7/95. M-Albian.
5, 6 *Klukisporites foveolatus* POCOCK 1964.
Olaszfalu (Bakony Mts). Bore Pe-31, 307/8. P: 35/100,2. L-Cenomanian.
7, 8 *Klukisporites scaberis* (COOK. et DETT. 1958) DETTMANN 1963.
Tatabánya Basin, Bore Ta-1364, 300/1. P: 31/98. Lower Albian
9, 10 *Klukisporites lacunus* FILATOFF 1975.
Bikol (Gerecse Mts), Bore Süttő-3, 30/3. P: 33/112. Lower Albian.
11, 12 *Foveasporis agathoecus* (R. POT. 1934b) W. KR. 1959b.
Olaszfalu (Bakony Mts), Bore Pe-31, 351/1. P: 29/98. L-Cenomanian.

Plate 1



Diagnosis: trilete miospores, with subtriangular or circular amb, convex (rarely straight) sides. Laesura is simple, generally long. Exine is generally thick (sometimes cingulum-like). Both the proximal and distal surfaces are ornamented, sunken into the exine, of irregular shape, sometimes with anastomising, longer or shorter, smaller or wider foveae-foveolae, mostly forming foveorugulate surfaces.

Differential diagnosis: *Fueloepisporites* nov.gen. is distinguished from the genera *Klukisporites* and *Ischyosporites* by the fact that its distal surface is not foveoreticulate and its proximal surface is foveate — foveorugulate, never being smooth. The foveae of *Foveosporites* W. KR. are regular, circular, they do not anastomose. *Foveosporites* BALME 1957, of affinity with the *Lycopodiaceae*, has thinner exine, smaller size, more regular foveolae. In the new genus, the anastomosis of foveae-foveolae may sometimes bring about a canal, thus it may be similar to the genus *Bikolisporites* (al. *Corrugatisporites*) JUHÁSZ 1972, in which the proximal surface is of corrugate ornamentation. The latter genus has, however, much thinner exine and has no foveolae. Transitional forms, however, can be observed toward this genus.

Further species to be ranged into the genus:

1. *Fueloepisporites* (al. *Trilites*) *asolidus* (W. KR. 1959b) n.comb.
2. *Fueloepisporites* (al. *Ischyosporites*) *foveasolidus* (W. KR. 1967) n.comb.
3. *Fueloepisporites crassus* n.fsp.
4. *Fueloepisporites vokanyensis* n.fsp.
5. *Fueloepisporites minor* n.fsp.
6. *Fueloepisporites rotundus* n.fsp.

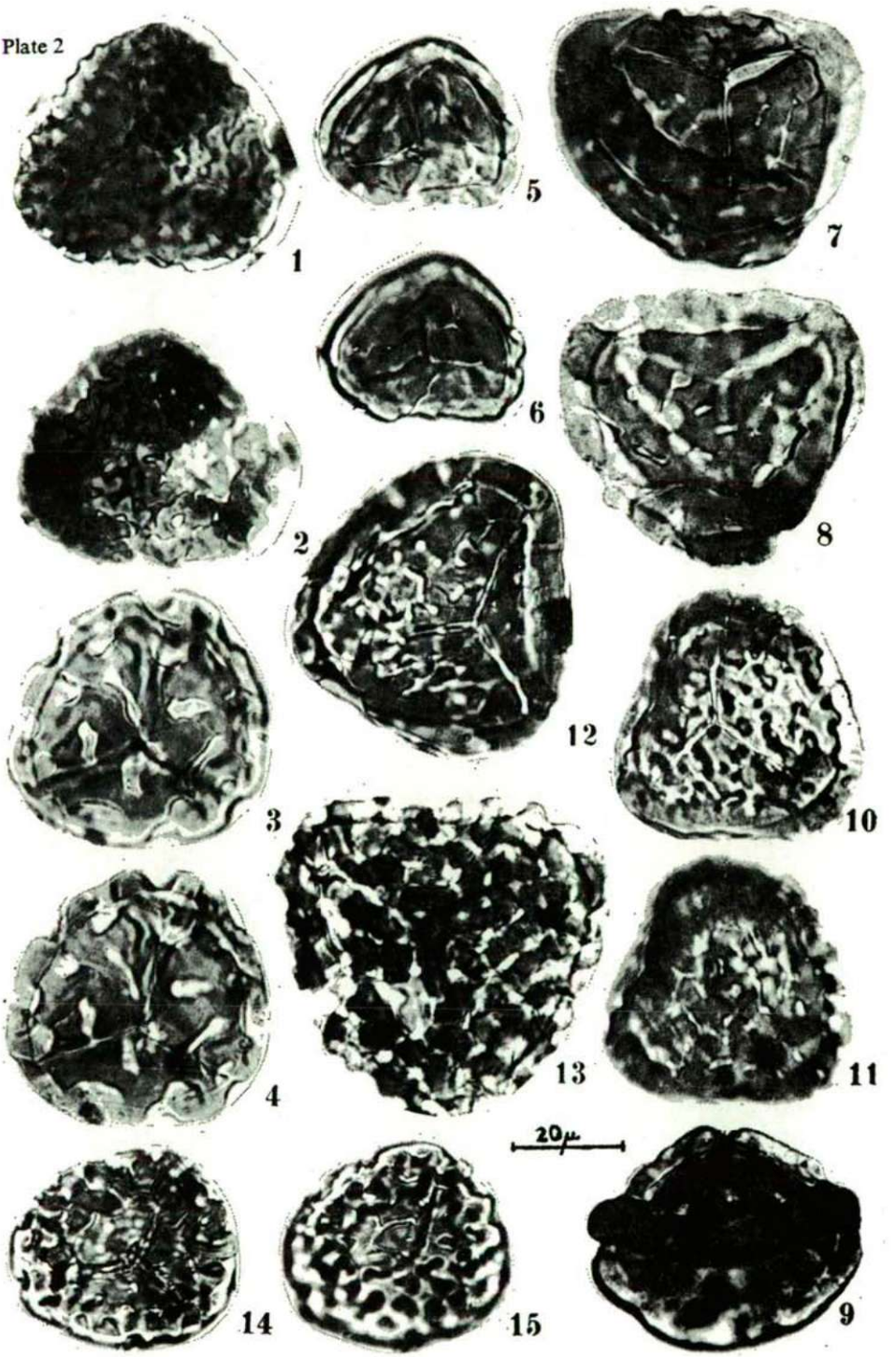
Fueloepisporites hungaricus n.fsp.
Pl. 2., figs. 3, 4.

Holotype: Pl. 2., figs. 3, 4. Prep.: Pgy-4, 69/1. P: 34/95.2.
Locus typicus: Pénzesgyőr (Mts Bakony) Bore Pgy-4, 69.5 m.
Stratum typicum: Pénzeskút Formation, marl. Upper Albian.

PLATE 2

1, 2 *Klukisporites tuberosus* (DÖRING 1965) n. comb.
Bikol (Gerecse Mts), Bore Süttő-3, 104/2. P: 37,5/108,2. L-Albian.
3, 4 *Fueloepisporites hungaricus* n. sp.
Pénzesgyőr (Bakony Mts), Bore Pgy-4, 69,5/1. P: 34/95,2. U-Albian.
5, 6 *Fueloepisporites minor* n. sp.
Tatabánya Basin, Bore Ta-1329, 480,5/1. P: 32,2/100,3. Neocomian.
7, 8 *Fueloepisporites crassus* n. sp.
Tatabánya Basin, Bore Ta-1358; 369,5/2. P: 33,6/106. Lower Albian
9 *Fueloepisporites crassus* n. sp.
Tatabánya Basin, Bore Ta-1495; 360/1. P: 40,8/105,8. Lower Albian.
10, 11 *Fueloepisporites vokanyensis* n. sp.
Tatabánya Basin, Bore Ta-1495; 378/1. P: 45,4/110. Lower Albian.
12 *Fueloepisporites vokanyensis* n. sp.
Vokány (Villány Mts), Bore Vo-4, 67/2. P: 38/94. Albian.
13 *Fueloepisporites* cf. *foveasolidus* (W. KR. 1967) n. comb.
Oroszlány (Bakony Mts), Bore O-1891; 545/1. P: 37/106,7. M-Albian.
14, 15 *Fueloepisporites rotundus* n. sp.
Sümeg (Bakony Mts), Bore Süt-17; 320/2. P:46,5/95,2. U-Barremian.

Plate 2



Diagnosis: trilete miospores, with circular amb, convex sides. Laesura is thin, straight, r=1. Both at the proximal and distal surfaces, sunk into the exine, irregularly running, generally longitudinal foveae can be found. The foveae are 6–11 μ long, 3–4 μ wide, and 2–3 μ deep, anastomosing rarely. The exine is 5 μ thick, becoming only 1–1.5 μ thick at foveae.
Spore size: 46 μ.

Differential diagnosis: *Fueloepisporites hungaricus* n.fsp. differs from the foveate-foveoreticulate species in having its foveae sunk into the whole surface of the spore, formed "pond-like" and having an irregular shape, and in its thick exine, circular outline.

Occurrence: It first occured in the lower part of the Pénzeskút Formation. We have not found it in older rocks.

Fueloepisporites minor n.fsp.
Pl. 2., figs. 5, 6.

Holotype: Pl. 2., figs. 5, 6. Prep.: Ta-1329, 480/5. P: 32.2/100.3.
Locus typicus: Tatabánya Basin, Borehole Ta-1329, 480.5 m.
Stratum typicum: Neocomian sandstone.

Diagnosis: trilete miospores, with rounded amb, convex sides. Laesura is simple, straight, r=1. Exine is 2.5–3 μ thick. Both at the proximal and distal surfaces, there are narrow, long foveorugulate canals, sunk into the exine. Their length can be 3–6 μ; sometimes they "meet".
Spore size: 32–38 μ.

Differential diagnosis: *Fueloepisporites minor* n.fsp. differs from the other species classified in this genus, in its small size and its narrow, canal-like foveorugulae.

Occurrence: it is mainly to be found in the Neocomian sediments of the deep bores in the environs of Tatabánya.

Fueloepisporites crassus n.fsp.
Pl. 2., figs. 7–9.

Holotype: Pl. 2., figs. 7, 8. Prep.: Ta-1358, 369/2. P: 33.6/106.
Locus typicus: Tatabánya Basin, Borehole Ta-1358, 369.5 m.
Stratum typicum: lower part of Vértessomló Formation, Lower Albian.

Diagnosis: trilete miospores, with subcircular amb, convex sides and strongly rounded corners. Laesura is straight, r=3/4. Exine is smooth, 5–6 μ hick, witdened out cingulum-like. Sunk into its surface are narrow foveorugulae wihch are rarely roundish, generally of irregular shape, and by anastomosing may even form a convolute-corrugate-like surface on the proximal side. The distal surface is strongly convex, the foveae, found sunk into its surface, are roundish, elongated, sometimes anastomosing.
Spore size: 45–60 μ.

Differential diagnosis: *Fueloepisporites crassus* n.fsp. differs from the other species arranged into this genus in its very thick exine and its corrugate-like proximal surface. Bikolisporites toratus (WEYLAND et GREIFELD) JUHÁSZ is somewhat similar to the described species but it has much thinner exine and on its proximal and distal sides the surface is corrugate in a regular fashion.

Occurrence: In Hungary, in the aleurolithic sediments of Vértessomló Formation and Sümeg Formation. (Barremian to Lower Albian).

Fueloepisporites vokanyensis n.fsp.
Pl. 2., figs. 10–12.

Holotype: Pl. 2., figs. 10–12. Prep.: Ta-1495, 378/1. P: 45.41ı.0.
Locus typicus: Tatabánya Basin, Borehole Ta-1495, 378 /m
Stratum typicum: Vértessomló Formation, grey marl, Lower Albian.

Diagnosis: trilete miospores, with triangular-subtriangular amb, straight or convex sides, strongly rounded corners. Laesura is simple, straight, r=3/4. Exine is 3–4 μ thick. Both the proximal and distal surfaces are ornamented with irregularly running, mostly elongated, narrow foveolae of varied shape, anastomosing only rarely and uniformly ornamenting the whole surface of the spore.
Spore size: 42–68 μ.

Differential diagnosis: *Fueloepisporites vokanyensis* n.fsp. differs from *F. crassus* n.fsp. in its triangular shape thinner exine, uniformly foveorugulate surface. *Fueloepisporites asolidus* (W. Kr. 1959b) n.comb. is of smaller size, its ornamenting elements form a positive foveorugulate surface. The foveolae of *Fueloepisporites foveasolidus* (W. Kr. 1959b) n.comb. are wider and form larger cavities.

Occurrence: This form generally occurs in the Lower- (more rarely in the Middle-) Albian sediments in Hungary (Gerecse and Villány Mts) but in the Tés Formation (Bakony Mts) it has not yet been found.

Fueloepisporites rotundus n.fsp.
Pl. 2., figs. 14, 15.

Holotype: Pl. 2., figs. 14, 15. Prep.: Süt-17, 320/2. P: 46.5/95.2.
Locus typicus: Sümeg (Bakony Mts); Bore Süt-17, 320.2 m.
Stratum typicum: Sümeg Formation, clayey marl, Upper Barremian.

Diagnosis: trilete miospores, with circular amb, rounded sides. Laesura is short, r=1/2. Exine is 2 μ thick, The proximal and distal surfaces are rugulate. Between rugulae roundish or long, narrow foveolae run and sometimes anastomose.
Spore size: 35–42 μ.

Differential diagnosis: This form is intermediate between *Fueloepisporites minor* n.fsp. and *F. vokanyensis* n.fsp. It differs from these two other forms, however, in its characteristic rotund shape and short laesura.

Occurrence: In the Barremian-Aptian stages of the Lower Cretaceous it is a fairly frequent species in Hungary; in the Lower Albian rocks it occur rarely.

Fueloepisporites cf. *foveasolidus*
Pl. 2., fig. 13.

Occurrence: This foveorugulate form of comparatively large size is a rare species occurring in the Sümeg- and Vértessomló Formations.

Genus: ACRITOSPORITES (Obonizkaja 1964) emend.

Emended diagnosis: trilete spores, with triangular or subcircular amb and generally convex, rarely straight sides. Laesura is straight and often bordered by generally long, sometimes thick torus or protruding kyrtom. On the proximal sur-

face of the spore circular or elliptical depressions (lacunae) may occur, caused by the thinning of the exine; on the distal surface one (rarely two) lacuna can be also found. In these lacunae. On the proximal side, one or two spherical tubercula can occur; on the distal side one (sometimes this is absent). The further parts of the exine are either smooth or with verrucate-rugulate ornamentation.

Type species: *Acritosporites aralensis* OBONIZKAJA 1964
Further species classified in this genus:

1. *Acritosporites sibiricus* (BOLCH. 1961) OBONIZ. 1964
2. *Acritosporites excavatus* (BRENNER 1963) n.comb.
3. *Acritosporites* (al. *Chomotriletes*) *triangularis* (DEÁK 1965) n.comb.
4. *Acritosporites* (al. *Chomotriletes*) *oculatus* (DEÁK 1965) n.comb.
5. *Acritosporites kyrtomus* n.fsp.
6. *Acritosporites transdanubicus* n.fsp.
7. *Acritosporites rasellus* (ALEKS. 1962) n.comb.

Acritosporites kyrtomus n.fsp.
Pl. 3., figs. 1, 2.

Holotype: Pl. 3., figs. 1, 2. Prep.: Pe-31, 215/1. P: 42.8/107.2.
Locus typicus: Olaszfalu (Bakony Mts), Bore Pe-31, 125 m.
Stratum typicum: Pénzeskút Formation, marl, Lower Cenomanian.

Diagnosis: trilete miospores with triangular-subcircular amb, convex sides, and rounded corners. Laesura is long, straight, r=1, bordered on the two sides by a thick, 4–7 μ wide and 2–4 μ high kyrtom. On the proximal surface there are three lacunae, in each of which one spherical tuberculum of 8–11 μ diameter is located. On the distal surface there is one central lacuna, with a tuberculum of 11–13 μ size in the middle. Exine is 3–5 μ thick; in the further parts of both surfaces it is smooth. Spore size: 60–68 μ.

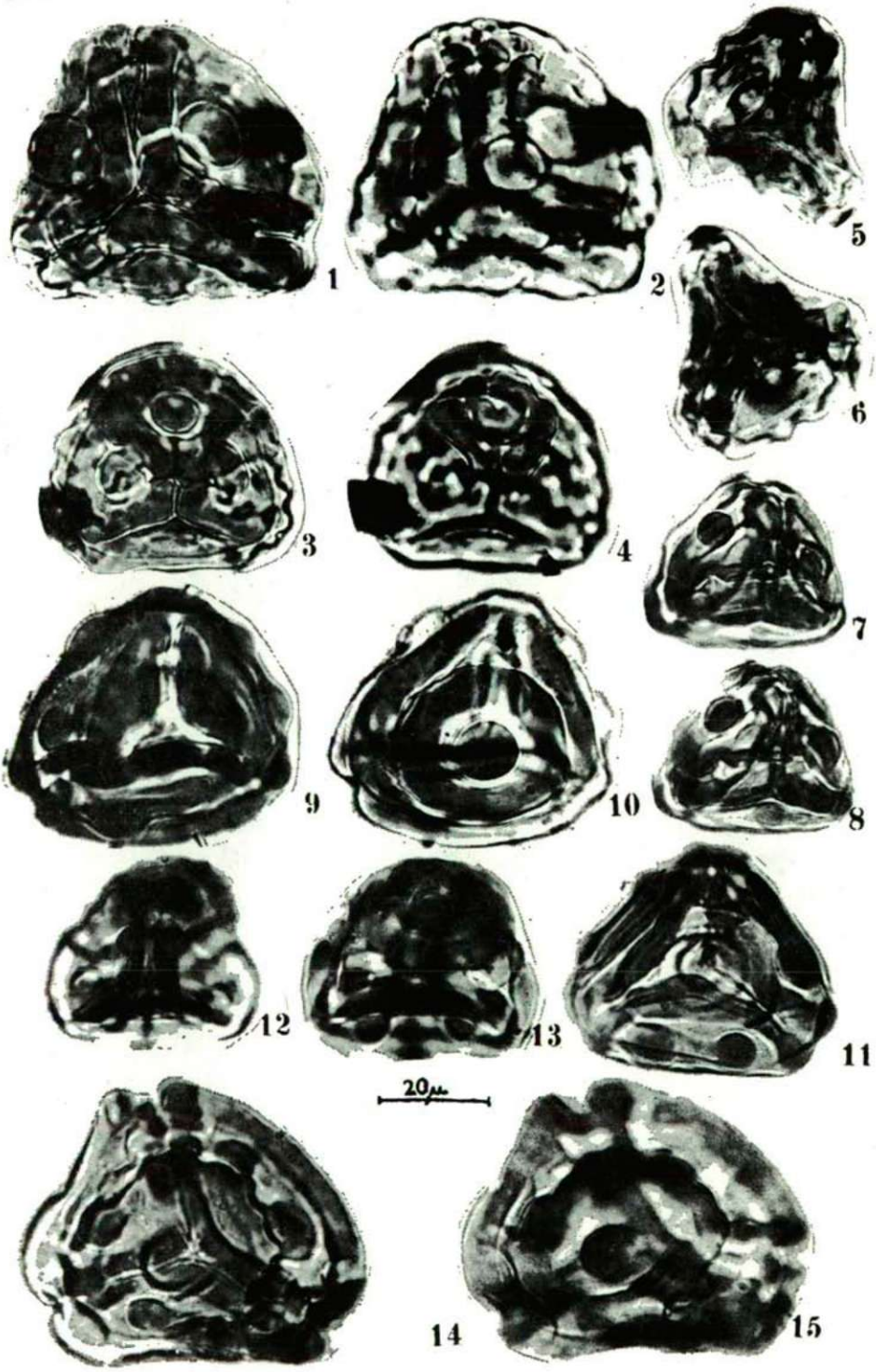
Differential diagnosis: The new species differs from Acritosporites sibiricus in having not seven but only four tubercula and a protruding well developed kyrtom. *Acritosporites triangularis* has no tuberculum on the proximal side, while *Acritosporites oculatus* has two tubercula on the distal surface.

Occurrence: In the upper part of Pénzeskút Formation (Lower Cenomanian).

PLATE 3

1, 2 *Acritosporites kyrtomus* n. sp.
Olaszfalu (Bakony Mts). Bore Pe-31; 215/1. P: 42,8/107,2. L-Cenomanian
3, 4 *Acritosporites transdanubicus* n. sp.
Olaszfalu (Bakony Mts) Bore Pe-31; 351/4. P: 29/105. L-Cenomanian.
7, 8 *Acritosporites transdanubicus* n. sp. Holotype.
Olaszfalu (Bakony Mts), Bore Ot-83; 30/1. P: 40,9/102. M-Albian.
5, 6 *Acritosporites* cf. *triangularis* (DEÁK 1965) n. comb.
Urkút (Bakony Mts), Bore U-4, 44,4/5. P: 29/99. Middle Albian.
9, 10 *Acritosporites sibiricus* (BOLCH. 1961) OBONIZ. 1964.
Zirc (Bakony Mts) Bore Zt-61; 69,5/1. P: 35,8/98,3. M-Albian.
11 *Acritosporites sibiricus* (BOLCH. 1961) OBONIZ. 1964.
Oroszlány, (Bakony Mts) O-1891; 521/2. P: 45,5/103,5. M-Albian.
12, 13 *Acritosporites sibiricus* (BOLCH.) OBONIZ. f. *minor* n. f.
Tés (Bakony Mts). Tt-27; 39/1. P: 36,9/106. Middle Albian.
14, 15 *Acritosporites rasellus* (ALEKS. 1962) n. comb.
Olaszfalu (Bakony Mts), Pe-31; 307/4, P: 41/108. Lower Cenomanian

Plate 3



Acritosporites transdanubicus n.fsp.
Pl. 3., figs. 3, 4 and 7, 8.

Holotype: Pl. 3., figs. 7, 8. Prep.: Ot-83, 30/1. P: 40.9/102.
Locus typicus: Oroszlány (Vértes Mts), Bore Ot-83, 30.0 m.
Stratum typicum: Tés Formation, clayey marl, Middle Albian.

Diagnosis: trilete miospores, with triangular amb, convex sides, and rounded corners. Laesura is simple and does not project from the surface of the spore. On the proximal surface three lacuna occur, in each of which is located one spherical tuberculum of 4–7 μ diameter. In the middle of the distal surface there is a lacuna, generally surrounded by a ring-like border, 2–3 μ thick. In this, centrally, a tuberculum 8–10 μ in size is located.
Spore size: 33–42 μ.

Differential diagnosis: *Acritosporites transdanubicus* n.fsp. similarly to *A. kyrtomus* n.fsp. has an exine ornamented only with four tubercula but it is of smaller size than that of the latter species, and with a thinner exine (2–2.5 μ thick) with no torus in it.

Occurrence: The genus *Acritosporites,* represented by this species, first appears in the upper level of the Vértessomló Formation and even in the Pénzeskút Formation several specimens occur. (Lower Albian to Lower Cenomanian).

Acritosporites cf. *triangularis* (DEÁK 1965) n.comb.
Pl. 3., figs. 5, 6.

1965 *Chomotriletes triangularis* BOLCH., DEÁK, p. 60, Pl. 3, figs. 1–4. (non *Chomotriletes triangularis* BOLCH. 1956).

Diagnosis: see DEÁK (1965, p. 60), as a description.

Remarks: DEÁK (1965) described a species that has lacunae on its proximal surface but tuberculum occur only in the distal lacuna. This species forms, therefore, a transition between the form *Acritosporites* (al. *Matonisporites*) *excavatus* described by BRENNER (1963), having only a distal lacuna, and the form *Acritosporites aralensis,* described by OBONIZKAJA (1964), having proximal and distal lacunae, as well as the species having tuberculum in lacunae *(A. sibiricus, A. transdanubicus).*

Occurrence: Tés Formation (Bakony—Vértes Mts).

Acritosporites sibiricus (BOLCH. 1961) OBONIZ. 1964
Pl. 3., figs. 9–11.

1961 *Lygodium sibiricum* n.sp., BOLCHOVITINA, p. 84, Pl. 27, fig. 4., Krasnoyarsk (USSR), Cenomanian—Turonian.
1963 *Taurocusporites spackmanii* n.sp., BRENNER, p. 69–70, Pl. 22, figs. 2, 3. Potomac Group, II/B, Albian.
1964 *Acritosporites sibiricus* (BOLCH. 1961) n.comb., OBONIZKAJA, p. 123–124, Pl. 10, fig. 5. Kizikum (USSR), Cenomanian—Turonian.
1966 *Lygodium sibiricum* BOLCH., MARKOVA, p. 218, Pl. 2, fig. 24. West-Siberia (USSR), Cenomanian—Turonian.

Remarks: OBONIZKAJA (1964) recorded the sizes of ten specimens and obtained the following size-limits at this species: spore size = 47.9–80 μ; length of laesura = 11.3–29.7 μ; thickness of the exine = 3.1–5 μ; diameter of distal lacuna = = 25.5–33.2 μ; diameter of distal tuberculum = 10.0–25.1 μ; diameter of proximal

tubercula = 9.0–16.0 μ. On the basis of the sizes of the *Taurocusporites spackmanii* BRENNER 1963 and of presence of a torus and six proximal tubercula, it may be considered as a junior synonym of *A. sibiricus*. There are also six tubercula on the proximal surface of the torus-bearing form, described by DEÁK (1964) under the name *Chomotriletes oculatus*. On its distal surface, however, occur not one but two tubercula, in a lacuna surrounded by one ring.

Occurrence: *A. sibiricus* is in its Siberian sites is a characteristic spore of the Cenomanian—Turonian. In the Albian of Potomac Group of USA and in the Albian sediments in Hungary it can also been found.

Acritosporites sibiricus (BOLCH.) OBONIZ. 1964
f. *minor* nov. f.
Pl. 3., figs. 12, 13.

Remarks: The new form of the former species is of 34–40 μ size, with 1–3 μ thick exine. It is a spore with torus, having seven tubercula.

Occurrence: this form firstly appeared in the upper part of the Tés Formation but frequently can be found only in Pénszeskút Formation.

Acritosporites rasellus (ALEKS. 1962) n.comb.
Pl. 3., figs. 14, 15.

1962 *Lygodium rasellum* n.sp. ALEKSANDROVA (in ALEKSANDROVA, BOEVA, and GRIGORJEVA, 1962).

1966 *Lygodium rasellum* ALEKS, MARKOVA, p. 218, Pl. 2, fig. 23 a, b.

Description: trilete spore, with subcircular amb and convex sides. Laesura is long, r=1, on both sides bordered by a thick torus, which forms a thickened part of the exine. In the proximal lacunae six, in the distal lacuna one tubercula can be found, their diameter being 12–14 μ. The distal lacuna has a diameter of approximately 26 μ and is surrounded by a 4–5 μ thick, protruding ring of irregular outline. The exine is 4–6 μ thick, on the distal surface the part between the ring and the equatorial edge are of verrucate ornamentation.

Remarks: This species is similar to the *A. kyrtomus* n.fsp. with four tubercula, but having verrucate ornamentation on the distal surfaces.

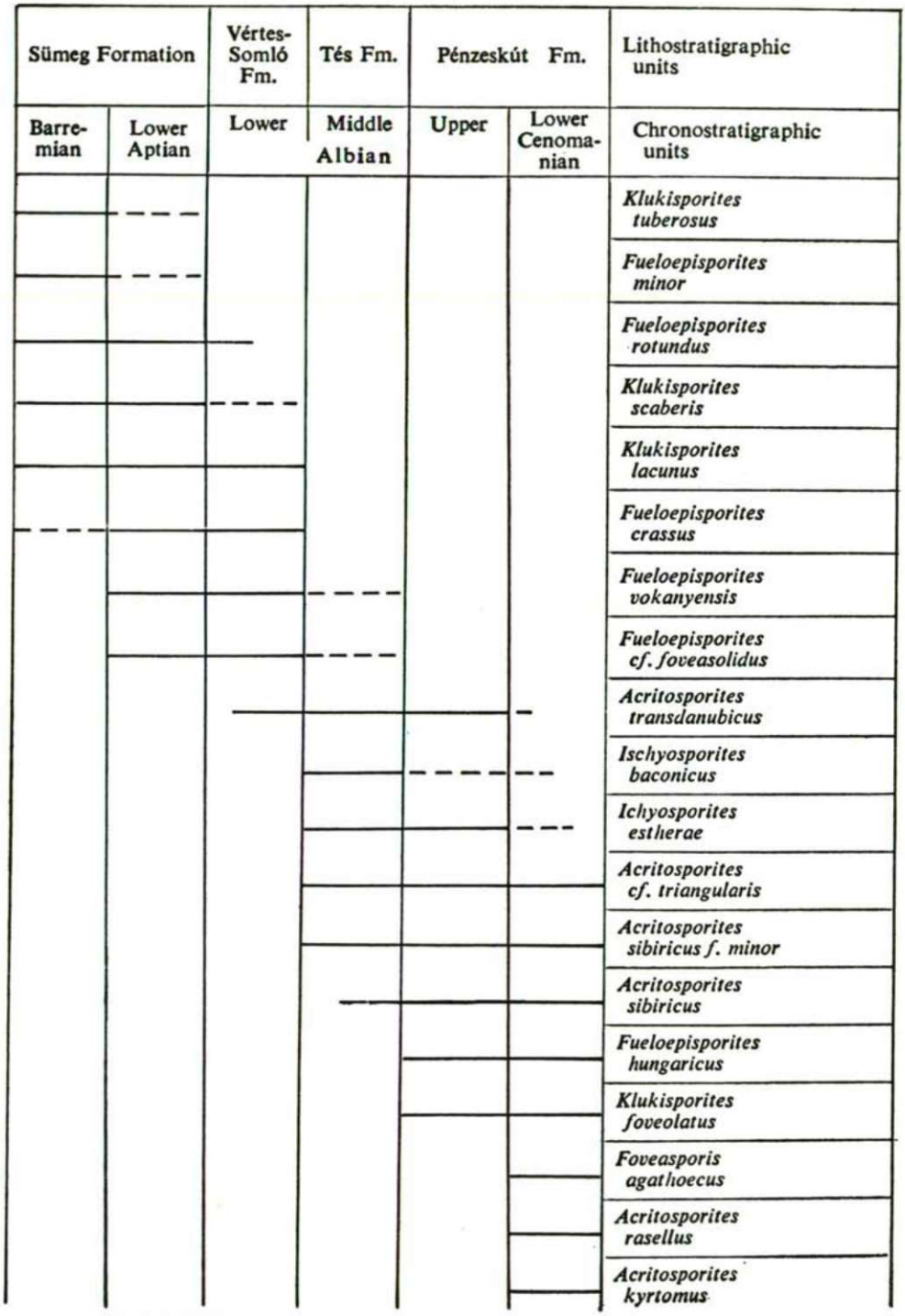
Occurrence: It is rare form of the sediments of Pénzeskút Formation (Lower Cenomanian).

Conclusion

In the taxonomic part, 19 sporomorph types are described, among these one new genus and nine new species. This demonstrates the great richness in ornamented spores of the Lower and Middle Cretaceous in Hungary.

Foveate, foveoreticulate, foveorugulate and raretuberculate forms are described and illustrated photographically. Taking into consideration their stratigraphical distribution in the Transdanubian Cretaceous sediments examined by us, the follow ing conclusions may be drawn from Table 1.:

Table 1. Stratigraphical distribution of the examined spores in the Transdanubian sediments



1. The Middle-Albian sediments (Tés Formation) have a central place on the time-axis of the spores examined here. The of certain species comes to an end here while that of other species begins here. In respect of the spore-pollen complexes, this period may be regarded as the time of change of the flora.

2. The majority of the species of the genera *Klukisporites* and *Fueloepisporites*, are characteristic of the Lower Cretaceous, up to the Lower Albian stage, while the representatives of the genera *Foveasporis* and *Acritosporites* appear from the Middle Albian, occur in the younger sediments.

In an earlier paper (JUHÁSZ, 1977), studying the Lower and Middle Cretaceous spores, we established that the large number of species of the schizaeaceous spores reflects the situation that the mother plants of the spores of this types had their acme at that time. We have suggested dealing with the *Lygodium*-type spores at the level of the family Lygodiaceae within the order Scizaeales. On this basis, we would classify among the spores of lygodiaceous and klukiaceous affinity several representatives of *Concavissimisporites, Impardecispora, Trilobosporites, Trilites* and, in all probability, we may also place here the species of the genera *Klukisporites, Ischyosporites, Foveasporis, Fueloepisporites* and *Acritosporites*.

COUPER (1958) placed the first described species of *Klukisporites* into the "relationship circle" of the Schizaeales, on the basis of their great similarity to the in situ spores of *Klukia exilis* (PHILLIPS) RACIBORSKI and *Stachypteris picans* POMEL, plants of schizaeaceous nature. Their place in this order is rendered probable by the species described by BALME (1957) as well. KRUTZSCH (1959b) on the problem of *Foveasporis agathoecus*, has asserted the schizaeaceous nature too.

BOLCHOVITINA (1961) and MARKOVA (1966) put the *Acritosporites* species in the genus *Lygodium* because, by the thick exine and the ornamentation of these forms, affinity with the Lygodiaceae is suggested. The thick exine and ornamentation of the species placed in *Fueloepisporites* new genus are very close those of the recent *Lygodium* spores. We suppose, therefore, that the spores considered in the present paper show the greatest affinity with the tropical fern family the Lygodiaceae and Klukiaceae which have been lived the acme-stage in the Lower and Middle Cretaceous.

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